

at last cease entirely, without reaching the anterior end of the vertebral column. On the other hand, *Branchiostoma lubricum* shows us the opposite extreme; the chorda passes beyond the anterior end of the skull, beyond the mouth and the eyes, far into the extremest end of the snout.

"This remarkable fact, first observed by Sundevall, was very surprising to me, since in consequence of my studies up till that time, I regarded the existence of three vertebræ in the proper cerebral cranium as certain, at least I considered the assumption of a fourth ethmoidal vertebra to be uncertain and undemonstrated.

"For now I saw at once, that it was undoubtedly possible that the cephalic vertebral column might extend further forwards. There need not always be three cranial vertebræ developed in the head; in birds, reptiles, and fishes, the most anterior vertebra is abortive, and is even entirely wanting in some families; but, in the *Mammalia* and man, three cranial vertebræ are without exception discoverable in the basis cranii, either in the fetus, or in many cases even in young or middle-aged animals—the occipitale basilare, sphenoideum basilare, posterius and anterieus; these also occur in fish. How far the chorda primitively extends in *Mammalia* is not yet made out; but even although it should not reach through the whole basis cranii, this, from the reasons which have been stated, would be no good argument."—Joh. Müller, *Bericht*. cclxviii–ix., Müller's *Archiv*, 1843.

"Report of the Joint Committee of the Royal Society and the British Association, for procuring a continuance of the Magnetic and Meteorological Observatories." With Appendix, containing Letter of General Sabine to the Committee. Communicated by order of the President and Council.

At the Meeting of the British Association which was held at Dublin, in August 1857, a resolution was adopted, proposing the continuance of the system of magnetical observations which was commenced under the auspices of the Royal Society, and of the British Association, in 1840; and a Committee, consisting of the President of the Association, the Rev. Dr. Robinson, and Major-General Sabine, was appointed, to request the cooperation of the President and Council of the Royal Society in the endeavour to attain this object, and to take, in conjunction with them, such steps as may appear desirable for that end.

The Committee thus appointed accordingly held a meeting in London, on the 5th of November last, at which it was agreed to recom-

mend that hourly observations, for not more than five years, should be undertaken at certain stations in the British Colonies; and a letter was addressed to the President of the Royal Society, asking for his cooperation, and that of the Council of the Society, in endeavouring to attain that object.

This application was favourably received by the Council of the Royal Society; and on the 10th of December, 1857, the following resolution was adopted in reference to it:—

“That Sir John Herschel, the Astronomer Royal, the Dean of Ely, and Dr. Whewell, be appointed a Committee, to cooperate with the Committee appointed with this view by the British Association, and to take, in conjunction with them, such steps as may be necessary, including, if it be thought desirable, an application to Government.”

In consequence of this resolution, a correspondence took place among the members of the two Committees, which having resulted, it is believed, in a general agreement as to the course to be adopted, the joint Committee so acting in cooperation met at Leeds on the 24th of September, and in the first instance proceeded to inquire into the nature and scientific value of the results which have already been secured by the system of observation hitherto carried out, at the observatories maintained by the Government, at the joint recommendation of these two bodies, with a view to forming a distinct opinion whether they are such as to merit being regarded as a reasonable, and, what may be called, a remunerative return for the labour and thought bestowed upon them, and the very considerable expenditure of the public money incurred by them. In so doing, they have limited their views to the results, as compared with the expenditure, in the British Colonial Magnetic Observatories only, without taking into consideration those deducible from observations made under foreign auspices; and they find that, at the cost of an expenditure which may be reckoned at about £400 per annum (exclusive of the cost of instruments, outfit, and publication) for each of the several observatories at St. Helena, Toronto, Hobarton, and the Cape of Good Hope during the respective continuance of each, the accumulated observations, so far as they have yet been discussed, have produced the following results, which they consider as satisfactorily established by the discussion:—

In the first place, the mean state of the several magnetic elements for each of the stations, as reduced to a fixed epoch, has been obtained with a precision of which nothing previously done has afforded any example—emulating, in this respect, the exactness of astronomical determinations, and competent to serve as a fixed point of departure to the latest ages ; and this for each of the elements in question—the dip, the declination, and the intensity of the magnetic force.

Secondly, that at each station, the rate of regularly progressive secular change in all the three elements above mentioned has been ascertained with a degree of precision which contrasts strongly with the loose and inaccurate determinations of former times.

Thirdly, that the laws of the diurnal, annual, and other periodic fluctuations in the values of these elements, as exhibited at each station, have been established in a manner and with a decision to which nothing hitherto executed in any branch of science, astronomy excepted, is comparable ; and that the results embodied in the examination of these laws have laid open a view of magnetic action so singular, and so utterly unexpected, as to amount to the creation of a new department of science, and the detection of a completely novel system of physical relations : for that, in the first place, the systems of diurnal and annual magnetic changes have each been separated into two perfectly distinct and physically independent systems,—the one, at any particular station, holding its course according to laws depending solely on the sun's hour-angle at the moment of observation, and his meridian altitude at different seasons,—the other, comprehending all those movements which, under the name of magnetic storms, or “irregular disturbances,” have hitherto presented the perplexing aspect of phenomena purely casual, capricious in amount and in the particular occasions of their occurrence when regarded singly, has been shown, by these discussions, to be subject in its totality to laws equally definite with the others, though more dependent for their application on peculiarities of local situation. As regards the first of these systems of fluctuation, they find it demonstrated :—

That the sun's regular action on the magnetism of the globe is determined by a law of no small complexity and intricacy, but which, nevertheless, has been traced with precision and certainty, and shown to be referable, in the first place, and for one of its arbitrary coefficients, to the geographical situation of the place of observation with

respect to a certain line or equator on the earth's surface, which cannot yet be precisely traced for want of sufficiently numerous stations (but which seems to approach to the line of least intensity, and is very far from coinciding with the geographical equator),—and in the next, and for its other influential cause, to the fact of the sun's having north or south declination; so that the whole diurnal change in any one of the elements, and at any station, is made up of two portions, one of which retains the same sign, and a constant coefficient all the year round; the other changes sign, and varies in the value of its coefficient with the annual movement of the sun from one side of the equator to the other.

That, consequently, for a station on the magnetic equator (so defined), the *mean* amount of diurnal change is *nil*, when taken over the whole year, but that on any particular day in the year it has a determinate magnitude, which passes through an annual periodicity, with opposite characters in opposite seasons. And that for a station in middle latitudes the mean diurnal fluctuation is not *nil*, but such as during every part of the year to exhibit an easterly deviation in the morning hours, and a westerly in the evening hours, for stations north of the magnetic equator, and *vice versâ* for those south of it; but that the amount of this deviation, or the amplitude of the diurnal fluctuation, varies with the seasons, being exaggerated or partially counteracted by the alternate conspiring and opposing influence of the sun's declination during the summer and winter seasons.

As regards the irregular disturbances, though arbitrary and capricious in extent and in the moments when they may be expected, individually, they nevertheless obey, with great fidelity, the law of averages when grouped in masses, and treated separately from those of the former class. So handled they are found to conform in their average effect, at each of the twenty-four hours of the day, and on each day of the year, to the very same rules as regards the sun's daily and annual movement, with one remarkable point of difference, viz. that their hours of maxima and minima are not identical with those of the regular class, but that each particular station has, in this respect, its own peculiar hours, analogous to what is called the "establishment" of a port in the theory of the tides. And that in consequence, the superposition of these two systems of diurnal fluctuation gives rise to a series of compound variations analogous to the

superposition of two undulations having the same period but different amplitudes, and different epochal times; and that by attending to this principle, many of the most complex phenomena, such as that of a double maximum and minimum, with the occurrence of a nightly as well as a daily movement, are explained in a satisfactory manner.

The discussion of the observations already accumulated has further brought into view, and in the opinion of your Committee fully established, the existence of a very extraordinary periodicity in the extent of fluctuation of all the magnetic elements, and in the amplitude and frequency of their irregular movements especially, which connects them directly with the physical constitution of the sun, and with the periodical greater or less prevalence of spots on its surface—the maxima of the amount of fluctuation corresponding to the maxima of the spots, and these again with those of the exhibitions of the *Aurora Borealis*, which appears also to be subject to the same law of periodicity; a law, which as it does not agree with any of the otherwise known solar, lunar, or planetary periods, may be considered as, so to speak, personal to the sun itself. And thus we find ourselves landed in a system of cosmical relations, in which both the sun and the earth, and probably the whole planetary system, are implicated.

That the sun acts in influencing the earth's magnetism in some other manner than by its heat, seems to be rendered very probable by several features of this inquiry, and the idea of a direct magnetic influence exterior to the earth, is corroborated by the discovery of a minute fluctuation in the magnetic elements, having for its period not the solar but the lunar day, and therefore directly traceable to the action of the moon. The detection of this fluctuation by M. Kreil, from a discussion of the Prague observations, has been confirmed by the evidence afforded by those of our Colonial observatories, and appears to be placed beyond all question by the recent deductions for the horizontal force and the declination extending over three years of observation at the Cape of Good Hope, which General Sabine has submitted for your Committee's inspection, and in both which the fluctuations in question emerge in a very satisfactory manner, and one calculated to give a high idea of the precision of which such determinations are susceptible, when it is considered that the total amplitude of oscillation due to this cause in the direction of the Cape-needle is only about 16'' of angle.

Your Committee, looking at this long catalogue of distinct and positive conclusions already obtained, feel themselves fully borne out in considering that the operation in a scientific point of view has proved so far eminently remunerative and successful, and that its results have fully equalled in importance and value, as real accessions to our knowledge, any anticipations which could reasonably have been formed at the commencement of the inquiry.

Having satisfied themselves of the great and important value of the results already obtained, independent of the dormant interest as respects future discussion which the mass of observations accumulated continues to possess, and which it remains for future theoretical combinations to elicit,—your Committee next turned their attention to the question, whether and to what extent the maintenance of some or all of the old Colonial observatories, or the establishment of new ones for a limited term might be expected,—first to give additional certainty and precision to the determinations already obtained,—and secondly, to elucidate points imperfectly made out, and more especially geographical relations which determine the greater or less amount of discordance between the epochal hours of the regular and irregular diurnal changes—relations which no doubt involve the causes of the irregular fluctuations themselves (causes at present involved in the greatest obscurity),—and to obtain indications of the points in the earth's surface at which the forces producing them originate.

As regards the general question as to the desirableness of some continuation of the observations, it seems hardly to be referred to our consideration as a Committee—the resolutions came to both by the British Association and by the Council of the Royal Society, in the appointment of their respective Committees of cooperation, indicating an opinion already conclusively formed on the part of both bodies to that effect. They have felt it due to themselves, however, to come to an independent conclusion on that point, and having done so with perfect unanimity, on the grounds already adduced, and the expectations for the future which those grounds justify, they next address themselves to the consideration of the two points above indicated, and to the important questions—first, whether to recommend the continuance or resumption of the establishments at the former

stations, or the selection of new ones ; and secondly, with how *few* new or revived establishments, with how limited a scale as to extent and expense, and with how short a period as to the minimum term of their duration, the expectation of these advantages being secured could be compatible, and finally to fix upon the stations most desirable.

As regards the first point referred to, viz. the more complete establishment of the laws themselves, and the giving of greater numerical precision to their expression, the Committee are of opinion that the laws themselves are not likely to be subverted or contradicted by a larger series of observations at any station for which they have once been shown to prevail ; but that every new station differing much in geographical situation from the former, in which they might be found verified, with or without supplementary modifications, would undoubtedly add strength to the induction by which they have been concluded. Additional numerical precision on the other hand would only be attained by a continuance of observations at former stations, and is not a point of sufficient importance, in their opinion, to be entitled to any weight in opposition to considerations in favour of change,—while in the one important case in which such additional precision is especially desirable,—that of the solar period,—such additional precision will be acquired ultimately as a matter of course by continued observation at any one of the existing permanent observatories, of whose business magnetic observation forms a part as well as by any amount of Colonial establishments.

It is therefore mainly in the elucidation of obscure and difficult physical points, and in the probable extension of our knowledge of the geographical and other conditions on which the irregular disturbances depend, that our hope of advantage from further observation consists ; our conviction being that, without special observations at well-selected stations (selected, that is, with a view to these objects), there is little or no prospect of further progress. The *general character* of the magnetic phenomena may be considered as secured from loss ; but the great problem remains unresolved,—the local influences are yet to trace, and the only means of tracing them must consist in varying the position of our stations, so as to embrace great differences in geographical situation, and in conformity with such indications as can be gathered from our present experience. The magnetic esta-

blishments permanently existing in Europe and America are confessedly inadequate to afford the requisite information. The stations which have occurred to your Committee as most eligible, would be, Vancouver Island, Newfoundland, the Falkland Isles, Bermuda, Ceylon, Shanghai or some locality in China, and Mauritius ; but they are fully aware that to demand from the national purse the institution of observations at all these points, would be more than is warranted by any pressing necessity, and ought therefore not to be insisted on. Among them, the principal in point of interest (for reasons which will be presently mentioned), are Vancouver Island, Newfoundland, the Falkland Isles, and Pekin or some near adjacent Chinese station ; and the Committee consider that much valuable information would accrue from observations sufficiently prolonged at these, to which, therefore, they would be understood to limit their recommendation. In regard to the length of time over which they would desire to see the observations extended, they consider five years (being about half the solar period, and as being also sufficient to give a fair grasp of the secular change of the magnetic elements) as a period both in consonance with that which has been accorded on former occasions, and in some sort designated by the nature of the case.

The reasons which induce them to give a preference to these over the rest of the stations enumerated are as follows :—Between Toronto and Point Barrow the difference of the epochal hours of the irregular diurnal fluctuations is such as to amount to a complete opposition of phases, a circumstance which goes far to point out the latter station as being in the immediate neighbourhood of the origin of those irregular disturbances. Should observations be established at the two stations now proposed, there is every reason to hope, as will appear from a document drawn up at the request of the Committee by General Sabine, and with his permission appended to this Report, that the observations at Toronto, which have been partially re-established since 1855, would, with a view to cooperation for this especial purpose, be wholly resumed on a fitting application to the Colonial legislature. And, in addition to this, should an application, made to the Norwegian Government for the establishment, during the same period, of an observatory at the North Cape prove, successful (which there is every reason to hope, such an application made on a former occasion having been well received, and having ultimately failed owing

only to a want of attention to some point of diplomatic form in its mode of communication), we should then have a chain of stations in high northern latitudes, the results obtained at which being severally brought into comparison with those already procured at Point Barrow, and with each other, could hardly fail of bringing out some very positive conclusion.

As regards the proposal for a station at the Falkland Isles, it is presumed, from the general course of the magnetic line of minimum intensity, that this station will prove, in analogy to the Cape of Good Hope, and in contrast with the northern stations recommended, to have the character of an equatorial, or approximate equatorial, station; and in respect to that proposed in China, that it will complete and carry round the globe the chain of northern middle latitude stations,—the intermediate links being supplied by the Russian observatories, and by those which it is hoped may be established at the North Cape and at Toronto. As regards the Falkland Isles and Newfoundland, it should be noticed that there exist considerable facilities and conveniences for the comfortable establishment of an observatory there; and in respect of the other two, it may be remarked, that they are both points of great present interest, and that a determination of the meteorological as well as magnetic peculiarities of both would be important. The affections of a telegraphic wire by electric discharges in the nature of Aurora Borealis have already attracted attention, and produced confusion in the ordinary use of such wires, and constitute one of the motives for inquiry into the nature and laws of the so-called magnetic storms. It may also be observed that, in reference to the anomalistic equation of the sun's magnetic intensity, or the effect of its annual approach and recess due to the ellipticity of the earth's orbit, the influence of local temperature upon the observations requires to be eliminated, in order to bring this effect into evidence, by a combination of the results obtained at stations whose seasons are opposite.

In reference to the important consideration of keeping down as much as possible the outlay consequent on the establishment of these observatories, your Committee have given attention to the question whether it be desirable to continue, as heretofore, the printing of the observations *in extenso*—a measure resulting in the production of vast and costly volumes, and entailing a great amount of laborious super-

intendence. They consider that the form of the observations remaining unaltered, and the principles of their reduction being now rendered familiar, this would not be necessary, provided the original observations were registered in triplicate, and the copies separately deposited in different and secure custody for preservation and occasional reference when required, and provided that sufficient and well-digested abstracts of their reduced results were published. One series of observations, however, they consider must be excepted from this alteration of system,—those of a continuous nature, made on term days, **FOUR** of which per annum they desire to see still kept up,—and those taken on occasions of magnetic storms, when continuous observation is substituted for that on the regular hourly intervals; for the treatment of such observations is still a matter of scientific inquiry; and to render them available, in comparison with others, the complete register is indispensable.

Your Committee cannot but contemplate a revival of active interest and cooperative participation in the system of observation on the part of our Colonial and of Foreign Governments, when once it shall become known that the subject is resumed by our own Home Government in the manner recommended. On this subject they beg to refer to General Sabine's reply to their inquiries, already alluded to, which places in a distinct point of view the expectations which may justly be indulged on that score. In reference, moreover, to the personal and material establishment at each of the Government observatories, this document contains a summary of what is needed, and of what ought to be applied for.

And this leads your Committee to a point which they consider of such importance to the success of the whole proceeding, that they cannot help embodying their opinion on it in this Report. It is of little avail to accumulate observations unless their effective and complete reduction be provided for, and the assurance obtained that when reduced they will undergo such discussion and scientific treatment as shall elicit from them the laws of the phenomena of which they are the records. The zeal and ability with which the present Superintendent of the Government Magnetic and Meteorological Observatories has hitherto executed this task, if extended to the new series now called for, would afford that assurance in its fullest extent; and they earnestly trust that this will not be lost sight of in the

arrangements to be made in carrying out their proposals, if adopted.

There is another point to which your Committee consider their attention ought to be paid simultaneously with the establishment of the proposed observatories: it is that of the extension of Magnetic Surveys of the districts in their immediate neighbourhood, with a view to fixing the situation and direction of the iso-magnetic curves within some considerable adjoining area (in the case of the Falkland Isles—that of the whole group).

On this point the following remarks by General Sabine, in a communication addressed by him to us in reply to certain inquiries which we considered it right to make of him, are in the opinion of your Committee, conclusive in deciding them to recommend that provision be also made for the execution of such surveys, collaterally with the observations at the fixed stations.

“Recent observations in North America, discussed in the ‘Proceedings of the Royal Society’ for January 7th, 1858, have made known that the general movement of translation of the isoclinal and isogonic lines, which from the earliest observations have been progressing from west to east, has within a few years reached its extreme eastern oscillation, and that the movement in the reverse direction has already commenced; we live therefore at an epoch in the history of terrestrial magnetism, which we have reason to believe will be regarded hereafter—when theory shall have more advanced—as a highly important and critical epoch. The geographical position of the maximum force in the Northern Hemisphere appears to have reached its extreme easterly elongation, and from this time forth may be expected to move for many years to come towards the meridian which it occupied in Halley’s time, accompanied by a corresponding change in the positions and forms of the isodynamic, isoclinal, and isogonic lines in North America: a careful determination of the absolute values and present secular change of the three elements at this critical theoretical epoch, at stations situated on either side of the American continent, and nearly in the geographical latitude of the maximum of the force, would furnish therefore data for posterity, of the value of which we may have a very inadequate appreciation at present. I may refer to the discussion prefixed to the third volume of the Toronto Observations, to show that the means and methods with which

we are conversant are adequate for the purpose ; and I may indicate Vancouver Island and Newfoundland as colonies well-suited for establishments of the same nature as those of which the efficiency has been proved."

As regards the instrumental means to be employed, the Committee believe that the consideration of the subject would be more fitly undertaken by the Royal Society, who will probably think it right to appoint a special Committee, as was done on the former occasion, to consider it maturely, and to report upon it. Well as in general the instruments employed in the British Colonial Observatories have performed, it may be desirable to consider whether they could not be improved, by diminishing considerably the size of the magnetic bars employed. Small bars indicate more certainly the rapid magnetic changes ; they may be hardened more perfectly, and therefore vary less in their magnetic condition with changes of temperature ; they admit of more perfect protection from the effects of disturbing aerial currents ; and, finally, the instruments may be constructed at less expense, and may be grouped together in a smaller and less costly building.

The joint Committee therefore have finally agreed to the following resolutions, which they submit for approval to their respective appointing bodies :—

1. That it is highly desirable that a series of Magnetical and Meteorological observations, on the same plan as those which have been already carried on in the Colonial Observatories for that purpose, under the direction of Her Majesty's Board of Ordnance, be obtained, to extend over a period of not more than five years, at the following stations :—

1. Vancouver Island.
2. Newfoundland.
3. The Falkland Isles.
4. Peking, or some near adjacent station.

2. That an application be made to Her Majesty's Government, to obtain the establishment of observatories at these stations for the above-mentioned term, on a personal and material footing, and under the same superintendence as in the observatories (now discontinued) at Toronto, St. Helena, and Van Diemen Island.

3. That the observations at the observatories now recommended,

should be comparable with, and in continuation of, those made at the last-named observatories, including four days of term observations annually.

4. That provision be also requested at the hands of Her Majesty's Government, for the execution, within the period embraced by the observations, of magnetic surveys in the districts immediately adjacent to those stations, viz. of the whole of Vancouver Island and the shores of the strait separating it from the main land,—of the Falkland Isles,—and of the immediate neighbourhood of the Chinese observatory (if practicable), wherever situated,—on the plan of the surveys already executed in the British possessions in North America, and in the Indian Archipelago.

5. That a sum of £350 per annum, during the continuance of the observations, be recommended to be placed by Government at the disposal of the General Superintendent, for the purpose of procuring a special and scientific verification and exact correspondence of the magnetical and meteorological instruments, both of those which shall be furnished to the several observatories, and of those which, during the continuance of the observations for the period in question, shall be brought into comparison with them, either at Foreign or Colonial stations.

6. That the printing of the observations *in extenso* be discontinued, but that provision be made for their printing in abstract, with discussion; but that the term observations, and those to be made on the occurrence of magnetic storms, be still printed *in extenso*; and that the registry of the observations be made in triplicate, one copy to be preserved in the office of the General Superintendent, one to be presented to the Royal Society, and one to the Royal Observatory at Greenwich, for conservation and future reference.

7. That measures be adopted for taking advantage of whatever disposition may exist on the part of our Colonial Governments, to establish observatories of the same kind, or otherwise to cooperate with the proposed system of observation.

8. That in placing these resolutions and the Report of the Committee before the President and Council of the Royal Society, the continued cooperation of that Society be requested in whatever ulterior measures may be requisite.

9. That the President of the British Association be requested to act in conjunction with the President of the Royal Society, and with the Members of the two Committees, in any steps which may appear necessary for the accomplishment of the objects above stated.

10. That an early communication be made of this procedure to His Royal Highness The Prince Consort, the President elect of the British Association for the ensuing year.

Appendix.

Letter from General Sabine to the Committee.

St. Leonard's, June 26, 1858.

MY DEAR SIR,—You wish me to state for the consideration of the Committee, what *specific* measures for the continuance and extension of magnetical researches appear to me suitable to the present state of that branch of science, and at the same time sufficiently moderate and reasonable to justify the expectation that the portion of them which requires it may receive the sanction of Her Majesty's Government.

For this purpose it may be convenient to divide the subject generally under three heads, and to consider separately what may be expected,—

1st. From our own Government.

2nd. From our own Colonies.

3rd. From foreign Countries.

1st. *From our own Government.*

The establishment, for a limited period, of observatories in the three colonies,—

Vancouver Island,

Newfoundland,

The Falkland Islands,

on a similar plan to those which were established at Toronto, St. Helena, and Hobarton, and which have now ceased, having accomplished their objects. The "personnel" at each of these three observatories to consist of an officer, four non-commissioned officers, and one private, either of the Artillery or of the Engineers, with the same extra pay and allowance for incidentals as was the case in the observatories which have terminated. The instruments, both absolute and differential, to be of the same description as before, with of

course such modifications and improvements as experience has suggested. The instruments to be prepared at Kew, and the directors of the three observatories to be instructed there. The system of observation to be hourly ; Sundays, Christmas days, and Good Fridays excepted. The time to be employed to be mean astronomical time at the station, both for magnetism and meteorology. The observatories to be maintained until five complete years of observation are obtained. The number of term-days in each year to be reduced from twelve to four.

The public departments whose sanction will be required, are, the Treasury for the expense, and the General Commanding in Chief for the selection and appointment of the officers and non-commissioned officers. In addition to the officer for each observatory, a fourth officer will be required as an assistant to the General Superintendent, in carrying on, under his direction, the details of correspondence with the observatories. Total, four officers, twelve non-commissioned officers, and three privates.

2nd. *With reference to our own Colonies.*

As soon as the sanction of Government has been obtained for the observatories already named, the Governors of British Guiana, Mauritius, and Melbourne may be written to, suggesting that a communication should be addressed from each of those colonies to the Secretary of State for the Colonies, expressing the desire which is felt in the colony to participate in the proposed systematic researches, stating what facilities can be afforded, and what portion of the expense can be borne by the colony itself, and requesting to be placed in official communication with some suitable authority for the preparation of instruments, and for furnishing such instructions and advice as may be required.

The accompanying letter from Lieutenant Governor Walker, of British Guiana, to M. Sandeman (which has been just forwarded to me), will show how ready that colony is to take its part, and that it waits only for that measure of countenance and encouragement which it reasonably expects, and ought to receive, from the mother country. At Mauritius, a Meteorological Society, formed by the colonists themselves, is most actively and usefully employed in tracing out, by means of the logs of merchant vessels, the phenomena of the storms by which navigation in that vicinity is troubled ; and is making most

pressing appeals for an authorization which should enable them to add researches in magnetism to those in meteorology; having on the spot, in Captain Fyers, of the Royal Engineers, a person who would make an admirable director of such an establishment. At Melbourne, a proposition for a magnetic observatory and survey is now before the local government; means are abundant, but instruments and direction are wanting. Mr. Jeffery, so well trained in the Hobarton Observatory, is in that country, and is desirous of such employment, as M. Neumayer is of the survey. Melbourne would be a most important station for a magnetic observatory, as we might expect from it the verification or otherwise of the increase in the magnetism of the earth, at the period of the year when she makes her nearest approach to the sun.

Other colonies might follow the example; but in regard to these three, we are justified in expecting that, with suitable measures of encouragement, we should have thoroughly efficient establishments, carrying out the system of observation in its completeness.

3rd. *With reference to Foreign Countries.*

A proposition has recently been made to the Netherlands Government, by Dr. Buys Ballot (who fills the same official position in Holland that Admiral FitzRoy does in this country), for the establishment of a magnetic observatory in the Dutch Colony of Batavia; and Dr. Buys Ballot has written to inquire whether, in the event of the proposition being acceded to, two sets of instruments, one for Batavia and the other for Utrecht, could be prepared at Kew. An intimation that the British Government was about to resume and extend its magnetical researches, might be expected to have a favourable influence on the success of Dr. Buys Ballot's proposition, and might also lead to the adoption of our colonial system of observation in its full extent at the Batavian observatory.

The importance of the North Cape of Europe as a magnetical station, especially with reference to the connexion between the Aurora and the magnetic disturbances, has already been noticed in a preceding letter from me (that of May 13). The instruments which were prepared some years ago at the expense of the Royal Society, and were intended to be presented to the observatory at the North Cape (should one be established there by the Norwegian Government), are still in existence, and with a few modifications

might be applied to their original purpose. The re-establishment of magnetic observatories in the British Colonies might furnish a favourable occasion for reviving, in concert with M. Hansteen, a proposition for an observatory at the North Cape, which seems to have failed on the former occasion rather from an accident than from any real difficulty in the matter itself.

M. Secchi, of the Observatory of the Collegio Romano at Rome, has recently been supplied from Kew, at the expense of the Papal Government, with a complete equipment of magnetical instruments, similar to those which have done such good work in the British Colonial establishments. With the encouragement derived from the revival of active measures here, M. Secchi might hope to obtain the aid which he desires, in the way of temporary assistance, to enable him to carry out the complete system of observation, for which he is already provided with the instrumental means.

The concert which has prevailed between Russia and England in magnetic operations, gives reason to hope that renewed activity here might so far strengthen M. Kupffer's hands, as to enable him to carry out efficiently the hourly system of the three elements, at one at least of the stations in Eastern Siberia, the probable importance of which can scarcely be overrated.

A meteorological observatory has recently been instituted at Havana, and the director, M. Poey, has proposed to the Cuban authorities the purchase of magnetical instruments, to be prepared at Kew, and a sufficient increase of assistants to provide for observations to be made with them. M. Poey is active and intelligent, and has recently visited the principal magnetic institutions in Europe. He would not fail to avail himself of the support which his proposition would derive from the measures which might be taken here.

The Regents of the Smithsonian Institution at Washington have agreed to allot a portion of their funds to a magnetic observatory; but neither the instruments nor the system of observation have yet been determined: their decision might probably be hastened by the knowledge that active measures are in progress here.

Viewing the necessity of resorting to means of securing and ascertaining a precise correspondence between the magnetical and meteorological instruments which may come to be used in these operations, or in cooperation with them in other quarters, as well as their exact

and scientific adjustment, as also of securing a self-registered series of photographic delineations of the solar spots during its continuance—it is proposed that during the continuance of the observatories, an annual sum, not exceeding £350, should be taken on the estimate, and placed at the disposal of the General Superintendent for these purposes.

There is a point referred to in a former letter which will require the attention of the Committee. It is the question, whether the observations of the proposed observatories should be printed *in extenso*, or in abstract accompanied by a discussion of the principal results.

I remain, my dear Sir, faithfully yours,

EDWARD SABINE.

Sir John Herschel, Bart.

PAPERS READ.

- I. "On the Changes produced in the proportion of the Red Corpuscles of the Blood by the administration of Cod-Liver Oil." By THEOPHILUS THOMPSON, M.D., F.R.S.
Received April 30, 1858.

Influenced by a conviction that the peculiarities essential to any disease are often associated with characteristic changes in the blood, and that the efficacy of many remedies depends on their power of modifying such conditions of the blood, I have made it an object to take opportunities of ascertaining some particulars regarding the composition of that fluid in certain diseased conditions prior to the use of remedies, and also in patients affected with similar maladies, but whose symptoms under the employment of medicines have been materially ameliorated. In reference to the inquiry, the proportion of red corpuscles would appear to be a circumstance of special significance, and to this question I have directed my chief care. In pursuing the investigation, my attention has been particularly directed to cases of phthisis, as there was in this way afforded to me the greatest opportunity of comparing the largest amount of analogous instances.

On the 27th of April, 1854, I had the honour of presenting to the